Research Note

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HIGH-INTENSITY RAINSTORMS ON THE BOISE AND PAYETTE NATIONAL FORESTS

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Information about high-intensity rainstorms on national forests is needed in formulating criteria for watershed protection to prevent soil erosion from forest or range lands. Areal precipitation data are necessary to establish expected storm intensity-duration patterns, which serve as guides to determining minimum plant cover protection requirements. This paper summarizes records of storm durations, intensities, and depths for the past several years in the Boise, Idaho area.

Packer[1/] found that on granitic soils common in this area about 70 percent ground cover was the dividing point between very little erosion and rapidly increasing erosion. This protection requirement of 70 percent ground cover was based upon the amount of overland flow and erosion that resulted from the application of 3.6 inches of simulated rainfall per hour.

The applied rainfall intensity of 3.6 inches per hour has been challenged by certain interests as uncommon and unrealistic for range lands in this area. Precipitation records from recording rain gages compiled and presented in this report show that rainfall intensities of 3.6 inches per hour or more for several minutes occur often enough to refute this challenge. A short-duration, high-intensity storm, whose rate of precipitation exceeds the infiltration capacity of the soil, usually causes more overland flow, erosion, and subsequent stream-channel sedimentation than does a long-duration rainstorm of low intensity.

Precipitation data are scarce for the high-elevation back-country areas on the Boise and Payette National Forests in Idaho. Many available rainfall data are merely daily and monthly totals measured in standard Weather Bureau cans and precipitation storage gages at ranger stations, guard stations, and lookout towers. While these measurements of daily and monthly totals reflect total precipitation, they fail to provide accurate records of individual storm duration and intensity.

Rainfall data from recording rain gages operated prior to 1954 are available for only a few locations, such as Arrowrock substation and the Boise Basin Experimental Forest. Since 1954, personnel of the Boise Research Center, Intermountain Forest & Range Experiment Station, have installed and operated recording rain gages at various study sites throughout the Boise and Payette National Forests. Records from these rain gages provide much valuable information about the intensity or rate of rainfall during numerous spring, summer, and fall storms.

Table 1 lists the high-intensity storms that have been recorded at specific locations on the Boise National Forest, as well as some high-intensity storms recorded by the U.S. Weather Bureau at Boise between 1912 and 1959. Table 2 presents some recorded maximum intensities for short rainstorms at five locations on the Boise and Payette National Forests and from weather records for the City of Boise. Records of the storms on the two national forests were taken from charts of recording rain gages operated by Boise Research Center personnel. Note that for particular storm durations a station may have two or more intensities listed. These are for different months of the year and point out the fact that high-intensity rainstorms may occur at a station in any month from May through September, the period during which the recording rain gages are operated.

In general, the "excessive" precipitation intensities shown by underlining in tables 1 and 2 are rates that would exceed the infiltration capacity of soil derived from granite. However, depending on the percent of ground cover, soil type, soil moisture content prior to the storm, and the degree of compaction of the soil surface, lower intensity rates might also cause erosion and sediment flows into stream channels.

1/ Packer, Paul E. Status of research on watershed protection requirements for granitic mountain soils in southwestern Idaho. Intermountain Forest & Range Expt. Sta. Res. Paper 27. 1951.

Table 1.--High-intensity storms of record by location, date, and station elevation

Location and date	Station elevation	Duration (minutes) 5		10		15		20		25		30		35		40		60		80	
		Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.	Ppt.	Inch /hr.
											Inches										
Boise, Idaho[1]	2,700'																				
7/30-31/1912		0.05	0.60	0.14	0.84	0.17	0.68	0.26	0.78	0.33	0.79	0.41	0.82	0.51	0.87	0.58	0.87	0.95	0.95	1.09	0.82
6/18/1916		.07	.84	.13	.78	.20	.80	.34	1.02	.44	1.06	.50	1.00	.56	.95	---	---	---	---	---	---
5/18/1921		.15	1.80	.26	1.56	.42	1.68	.55	1.65	.64	1.54	.67	1.34	---	---	---	---	---	---	---	---
7/30/1934		.21	2.52	.33	1.98	.36	1.44	.37	1.11	.37	.89	.37	.74	.37	.63	.38	.57	---	---	---	---
5/16/1935		.19	2.28	.26	1.56	.35	1.40	.40	1.20	.42	1.01	.43	.86	.43	.73	.43	.64	.47	.47	.51	.38
6/6/1941	2,840'	.22	2.64	.38	2.28	.43	1.72	---	---	---	---	.49	.98	---	---	---	---	.51	.51	---	---
5/23/1942		.34	4.08[2]	.37	2.22	.37	1.48	---	---	---	---	.38	.76	---	---	---	---	.49	.49	---	---
6/12/1958		.10	1.20	.18	1.08	.24	.96	---	---	---	---	.42	.84	---	---	---	---	.73	.73	---	---
Boise N. F. Arrowrock Substation[3]	4,500'																				
5/27/1938		.09	1.08	.18	1.08	---	---	.34	1.02	---	---	.41	.82	---	---	.48	.72	.52	.52	.63	.47
5/11-12/1958		.05	.60	.10	.60	.18	.72	.20	.60	---	---	.28	.56	---	---	---	---	.52	.52	---	---
6/23/1958		---	---	.10	.60	.11	.44	.17	.51	---	---	.22	.44	---	---	---	---	.35	.35	---	---
B.B.E.F.[4] Lysimeter Station																					
8/10/1936	5,500'	.50	6.00	.74	4.44	.88	3.52	1.01	3.03	1.10	2.64	1.18	2.36	1.23	2.09	1.26	1.89	1.35	1.35	1.40	1.05
B.B.E.F. #1	4,950'																				
6/27/1954		.10	1.20	.19	1.14	---	---	.23	.69	---	---	.27	.54	---	---	---	---	---	---	---	---
5/29/1956		.22	2.64	.43	2.58	.55	2.20	.68	2.04	---	---	.71	1.42	---	---	.75	1.12	---	---	---	---
7/12/1956		.12	1.44	.14	.84	---	---	.17	.51	---	---	.18	.36	---	---	---	---	---	---	---	---
B.B.E.F. #2																					
9/8/1958	5,400'	.27	3.24	.41	2.46	.42	1.68	.42	1.26	.42	1.01	.43	.86	.43	.73	.44	.66	.44	.44	---	---
Little Owl Cr.																					
5/29/1956	6,050'	---	---	.10	.60	---	---	.33	.99	---	---	.43	.86	---	---	.54	.81	.63	.63	.68	.51
Morehead Mtn.																					
8/11-12/1957	8,500'	.05	.60	.11	.66	.21	.84	.29	.87	.36	.86	.46	.92	.51	.87	.56	.84	.77	.77	---	---

1/ Amounts and rates for Boise storms compiled from U.S. Dept. Agr., Weather Bureau, "Climatic Summary of the U.S." Section 6, S. Idaho, 1930, brought up to date (1959) by supplemental data on file in Weather Bureau Office, Boise, Idaho.

2/ Underlined rate/hr. figures are considered "excessive" precipitation rates.

3/ Data for all following storms from charts of recording rain gages operated by Boise Research Center, Intermountain Forest and Range Expt. Sta., Boise, Idaho.

4/ B.B.E.F.--Boise Basin Experimental Forest.

Table 2. Maximum rainfall intensities of short duration storms, Boise and Payette National Forests

Station	Date	Elevation	Ppt. depth	Intensity	Station	Date	Elevation	Ppt. depth	Intensity
		Feet	Inches	In./hr.[1]			Feet	Inches	In./hr.[1]
Maximum 1-minute rains					Maximum 7-minute rain				
Zena Creek	9/15/59	5,000	0.08	4.80	B.B.E.F. #1	9/ 8/58	4,950	0.47	4.02
B.B.E.F. #2	8/20/59	5,400	.07	4.20					
Little Owl Creek	6/13/58	6,050	.05	3.00	Maximum 8-minute rain				
Little Owl Creek	9/14/59	6,050	.05	3.00	B.B.E.F. #2	9/ 8/58	5,400	.41	3.08
B.B.E.F. #2	9/14/59	5,400	.05	3.00					
					Maximum 10-minute rains				
Maximum 2-minute rains					B.B.E.F. Lysimeter	8/10/36	5,400	.74	4.44
Little Owl Creek	8/19/59	6,050	.22	6.60	B.B.E.F. #1	9/ 8/58	4,950	.47	2.82
B.B.E.F. #1	9/ 8/58	4,950	.12	3.60	B.B.E.F. #1	5/29/56	4,950	.43	2.58
Little Owl Creek	6/13/58	6,050	.06	1.80	B.B.E.F. #2	9/ 8/58	5,400	.41	2.46
					Boise (City)	6/ 6/41	2,840	.38	2.28
Maximum 3-minute rains					Boise (City)	7/30/34	2,700	.33	1.98
B.B.E.F. #2	9/ 8/59	5,400	.18	3.60	B.B.E.F. #2	8/20/59	5,400	.32	1.92
B.B.E.F. #1	6/ 5/59	4,950	.13	2.60	Zena Creek	9/14/59	5,000	.30	1.80
Little Owl Creek	5/31/58	6,050	.06	1.20					
Little Owl Creek	9/ 8/58	6,050	.06	1.20	Maximum 15-minute rains				
					B.B.E.F. Lysimeter	8/10/36	5,500	.88	3.48
Maximum 5-minute rains					B.B.E.F. #1	5/29/56	4,950	.55	2.20
B.B.E.F. Lysimeter	8/10/36	5,500	.50	6.00	B.B.E.F. #1	9/ 8/58	4,950	.47	1.88
B.B.E.F. #1	9/ 8/58	4,950	.35	4.20	Boise (City)	6/ 6/41	2,840	.43	1.72
Boise (City)	5/23/42	2,840	.34	4.08	Boise (City)	5/18/21	2,700	.42	1.68
B.B.E.F. #2	9/ 8/58	5,400	.27	3.24	B.B.E.F. #2	9/ 8/58	5,400	.42	1.68
Zena Creek	9/13/59	5,000	.25	3.00	Boise (City)	7/30/34	2,700	.36	1.44
Boise (City)	6/ 6/41	2,840	.22	2.64					
B.B.E.F. #2	8/20/59	5,400	.22	2.64	Maximum 20-minute rains				
B.B.E.F. #1	5/29/56	4,950	.22	2.64	B.B.E.F. Hdqtrs.	9/ 8/58	4,400	1.12[2]	3.36
Boise (City)	7/30/34	2,700	.21	2.52	B.B.E.F. Lysimeter	8/10/36	5,500	1.01	3.03
Arrowrock Substation	6/ 8/58	4,500	.18	2.16	B.B.E.F. #1	5/29/56	4,950	.68	2.04
Little Owl Creek	5/29/56	6,050	.12	1.44	Boise (City)	5/18/21	2,700	.55	1.65
B.B.E.F. #1	7/12/56	4,950	.12	1.44	B.B.E.F. #1	9/ 8/58	4,950	.47	1.41
Little Owl Creek	8/19/59	6,050	.11	1.32					
B.B.E.F. #1	6/27/54	4,950	.10	1.20					
Arrowrock Substation	5/27/38	4,500	.09	1.08					

1/ Underlined figures indicate an "excessive" precipitation rate.
2/ Measured in standard Weather Bureau rain can; time estimated at 20 min. ±2 min.

Infiltration studies made on the Boise River watershed in 1939[2/] show the following infiltration rates for three major soil groups:

	Soils derived from--		
	Granite	Basalt	Sedimentary rocks
Number of sample stations	24	1	2
	Infiltration rate (in./hr.)		
Soil in normal condition	6.9	7.1	5.6
Soil in eroded condition (indicated by occurrence of erosion pavement, sheet or gully erosion, compacted surface soils, depleted ground cover, etc.)	2.8	1.5	2.0
Percent of watershed covered by this soil type*	75.4	9.4	15.2

* Source: Table II-A-14, p. 35, of report cited above.

2/ U.S. Department of Agriculture. Survey report. Runoff and waterflow retardation and soil erosion prevention for flood control purposes. The Boise River. 1940. (Table II-A-16, p. 37.)

This same survey report states:

> Accelerated erosion is occurring on 93 percent of the (Boise River) watershed. Slight erosion, as represented by removal of less than one-fourth of the topsoil, is occurring on one-fourth of the area. Moderate erosion, representing the removal of between one-fourth and one-half of the topsoil, is occurring on about one-half of the area, while moderately severe erosion, representing removal of one-half to three-fourths of the topsoil, is occurring on about one-eighth of the area. Severe erosion, representing removal of three-fourths to all of the topsoil and some subsoil is occurring on less than 1 percent of the area, chiefly in the form of gullies.

Based on the above stated infiltration rate of 2.8 inches per hour for eroded and depleted range lands, the following tabulation shows, for various periods of time, the actual amounts of rainfall beyond which erosion can be expected. This tabulation assumes rainfall at an intensity equaling the 2.8 inches per hour infiltration rate:

Duration . . . . . (minutes) . .	5	10	15	20	30
Precipitation . . . (inches) . .	0.23	0.47	0.70	0.93	1.40

The actual number of recorded high-intensity storms is a small percentage of the total number of such storms occurring on the Boise and Payette National Forests. But these exceptional storms are those upon which watershed protection criteria must be based. Additional data on storm intensities in the remote portions of these forests will be obtained as research is extended into the steep, formerly inaccessible timbered areas.

The devastating effects of high-intensity storms are most severe and spectacular on areas bared by logging, or where ground cover has been depleted or destroyed by excessive grazing and trampling.

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